Bull Trout Distribution, Movements and Habitat Use in the Umatilla and John Day River Basins

2012 Annual Progress Report

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February 21, 2013

Table of Contents

List of Figures

List of Tables

Abstract

The goal of the U.S. Fish and Wildlife Service's studies in the Umatilla and John Day basins is to provide information that can be used to develop recovery actions for bull trout (Salvelinus confluentus) listed as threatened under the Endangered Species Act. In the Umatilla Basin in 2012, we electrofished and collected habitat data in seven to nine 50-m sampling units in potential bull trout patches (identified through work in previous years of this study) to determine where bull trout populations currently exist, or might be established based on the presence of suitable spawning habitat. We also passive integrated transponder (PIT) tagged and took genetic samples from bull trout trapped in the upstream ladder at Three Mile Falls Dam in the lower Umatilla River to gain a better understanding of the movement and origin of those fish. In the John Day Basin, we flew the main stem John Day, North Fork John Day, and Middle Fork John Day rivers to identify the locations and types of structures in the stream channel that may create blockages to fish passage. We found no bull trout in patches in Buck, Spring, Shimmiehorn, and North Fork Meacham creeks and the South Fork Umatilla River. The probability of detecting bull trout in those patches, were the patches actually occupied, was estimated at 80 to 93%. A sixth potential patch in Johnson Creek was not sampled due to time constraints, but we believe the likelihood of it supporting a bull trout population is minimal due to limited flow in the stream section within the patch. Spawning habitat in the sampled patches was minimal to non-existent. Thus, it appears the bull trout population known to exist in the North Fork Umatilla River (in which a patch was identified, but which we did not sample because of the known presence of the population) currently may be the only local population in the basin. In addition, establishment of bull populations in the other patches in the near future may be unlikely. Three bull trout ranging in fork length from 305 to 380 mm were captured at Three Mile Falls Dam in May. One had been PIT tagged previously in the Walla Walla River in November 2011. Genetic analyses indicated all originated in the Walla Walla River. None were detected at any of the PIT tag detection sites in the Columbia River Basin during 2012. That they were not detected at Feed Canal Dam, at rkm 45 on the Umatilla River, suggests they did not migrate upstream out of the lower river. In the John Day Basin, we found 24 potential blockages to fish passage in the John Day River between river kilometers 140 and 442, one potential blockage in the Middle Fork John Day River near river kilometer 72, and no potential blockages in the North Fork John Day River. In consultation with personnel from the Oregon Department of Fish and Wildlife and Grant County Soil and Water Conservation District, we determined seven of the structures in the John Day River were lay flat stanchion dams designed to provide fish passage, and the remainder were push up dams, eight of which are proposed to be replaced by lay flat stanchion dams in 2013-19. The design of the sole structure in the Middle Fork John Day River could not be determined. If left intact after the irrigation season, the structures without fish passage in the John Day River might interfere with the movements of subadult and adult bull trout in fall and winter and limit production. Given the absence of impediments to fish passage (other than seasonally high stream temperatures) in the main stem of the North Fork John Day River, other factors must be limiting bull trout production in that system. This might also the case in the Middle Fork John Day River system, depending on the nature of the potential blockage identified in the main stem.

Introduction

Bull trout (*Salvelinus confluentus*) were officially listed as a Threatened Species under the Endangered Species Act (ESA) in 1998. The U.S. Fish and Wildlife Service (FWS) subsequently issued a Draft Recovery Plan (U.S. Fish and Wildlife Service 2002) which included chapters for the John Day Recovery Unit (Chapter 9) and the Umatilla-Walla Walla Recovery Unit (Chapter 10). The two chapters were updated in 2004 (U.S. Fish and Wildlife Service 2004a, 2004b), and are the current guide for recovery actions in the Umatilla and John Day basins. The goal of bull trout recovery planning by the FWS is to describe courses of action necessary for the ultimate delisting of this species, and to ensure the long-term persistence of self-sustaining, complex interacting groups of bull trout distributed across the species' native range (U.S. Fish and Wildlife Service 2004a. 2004b).

Bull trout are native to the Umatilla and John Day basins, and they exhibit two different life history strategies in those systems. Fluvial bull trout spawn in headwater streams and juveniles rear in these streams for one to four years before migrating downstream as subadults to larger main stem areas, and possibly to the Columbia River, where they grow and mature, returning to the tributary stream to spawn (Fraley and Shepard 1989). Downstream migration of subadults generally occurs during the spring, although it can occur throughout the year (Hemmingsen et. al. 2001a, 2002). These migratory forms occur in areas where conditions allow for movement from upper watershed spawning streams to larger downstream waters that contain greater foraging opportunities (Dunham and Rieman 1999). Stream-resident bull trout also occur in the two basins, and they complete their entire life cycle in the tributary streams where they spawn and rear. Resident and migratory forms of bull trout may be found living together for portions of their life cycle, but it is unknown if they can give rise to one another (Rieman and McIntyre 1993). Bull trout size is variable depending on life history strategy. Resident adult bull trout tend to be smaller than fluvial adult bull trout (Goetz 1989). Under appropriate conditions, bull trout regularly live to 10 years, and under exceptional circumstances, reach ages in excess of 20 years. They normally reach sexual maturity in four to seven years (Fraley and Shepard 1989; McPhail and Baxter 1996).

When compared to other North American salmonids, bull trout have more specific habitat requirements. The habitat components that shape bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrates, and migratory corridors (U.S. Fish and Wildlife Service 1998). Throughout their lives, bull trout require complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard 1989; Watson and Hillman 1997). Juveniles and adults frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997). McPhail and Baxter (1996) reported that newly emerged fry are secretive and hide in gravel along stream edges and in side channels. They also reported that juveniles are found in pools, riffles, and runs where they maintain focal sites near the bottom, and that they are strongly associated with instream cover, particularly overhead cover. Bull trout have been observed over-wintering in deep beaver ponds or pools containing large woody debris (Jakober et al. 1998). Habitat degradation and fragmentation (Fraley and Shepard 1989), barriers to migration (Rieman and McIntyre 1995), and reduced instream flows have all contributed to the decline in bull trout populations in the Columbia River Basin.

In summary, bull trout need adequate stream flows and temperatures and the corresponding habitat for each of the different life history functions at specific times of the year in order to persist. Habitat conditions must be adequate to provide spawning, rearing, and migration opportunities, cover, forage, seasonal movement, and over-wintering refuges.

The goal of the FWS's studies in the Umatilla and John Day basins is to develop information and analyses to assist in assessing the relative merit of potential action strategies in making progress towards meeting the requirements outlined in the Umatilla-Walla Walla and John Day Recovery Unit chapters of the Draft Recovery Plan (U.S. Fish and Wildlife Service 2004a, 2004b) for the recovery and delisting of bull trout. Specifically, FWS's studies were designed to address the following recovery plan objectives:

- Restore and maintain suitable habitat conditions for all bull trout life history stages and strategies, and

- Conserve genetic diversity and provide opportunity for genetic exchange.

The habitat objective should be accomplished through a series of steps designed to restore and maintain suitable habitat conditions for all bull trout life history stages and strategies. The first step should consist of defining the physical conditions that comprise suitable bull trout habitat. The second step should be application of these habitat "criteria" to current conditions to determine the extent of the relevant stream that currently provides suitable habitat. The third step should consist of determination of the changes required to improve habitat in areas indicated in the recovery plan that do not currently provide suitable conditions. The fourth step should consist of implementing changes to restore and maintain suitable habitat conditions for all bull trout life history stages and strategies.

The genetic diversity objective should be accomplished by maintaining connectivity among local populations of bull trout to facilitate gene flow and genetic diversity. As the recovery plan discusses, connectivity consists of maintaining the fluvial component of each local population which includes providing conditions that allow fluvial adults to effectively move between spawning and wintering areas, and ensuring that movement of both fluvial adult and subadult bull trout can occur, at least seasonally, between local populations within each core area in the recovery unit. This includes establishing the physical conditions necessary for up- and down-stream fish passage, and providing a continuum of suitable physical habitat to ensure the persistence of fluvial life stages and provide the opportunity for genetic interchange between local populations within each core area.

The approach the FWS used to plan studies in the two basins consisted of the following steps:

- Identify information needed to assess if criteria for recovery objectives are being achieved;

- To that end, design and implement studies to describe bull trout distribution, movement, and seasonal habitat use patterns;

- Use this information and results from these studies to assist in guiding actions that will make progress towards bull trout recovery.

We previously described what was known about the abundance, distribution, and migratory patterns of bull trout and potentially limiting physical conditions in the Umatilla Basin when we initiated our study there in 2004 (Anglin et al. 2008). To summarize, at that time, the only viable population of bull trout appeared to occur in the North Fork Umatilla River, and it appeared to be relatively small. Telemetry studies had shown fluvial adult bull trout did not migrate extensively, remaining within the upper Umatilla River and the North Fork Umatilla River to complete their life cycle (Sankovich et al. 2003, 2004; Oregon Department of Fish and Wildlife [ODFW], unpublished report). Little was known about the movement and seasonal distribution of subadults, but the available evidence suggested they also were not prone to undertake extensive migrations. Five bull trout had been captured in a ladder at Three Mile Falls Dam (TMFD) in the lower Umatilla River at river kilometer (rkm) 6 between 1995 and 2004. These fish were 254 to 330 mm in fork length (FL), indicating they were either subadults or first-time maturing adults when captured. Thus, assuming these fish originated in the Umatilla Basin, it appeared at least a small number of subadults produced there continued to migrate to and use the lower Umatilla and Columbia rivers. Although there were human impacts to the upper basin due to development, agriculture, and forest management, the major impacts occurred in the lower basin where there were six irrigation dams and diversions and sections of the river were sometimes dewatered seasonally. All but one of the diversion dams had ladders, but the ladders were designed for passage of salmon and steelhead, and it was not known if bull trout could negotiate them.

Between 2004 and 2011, the conditions in the Umatilla Basin that held the potential to negatively impact bull trout remained relatively unchanged. The population in the North Fork appeared to be small and stable or declining based on redd counts and mark-recapture abundance estimates (P.M.S., unpublished data; Budy et al. 2004, 2005, 2006, 2007, 2008, 2009). Because fluvial adult bull trout migrations had been studied previously and subadult migrations remained largely un-described, we chose to focus on the latter when we began our study in the basin. Through 2009, we used a combination of trapping, snorkeling, telemetry, and fixed passive integrated transponder (PIT) tag detection sites to determine the subadult population was small and individuals exiting the North Fork (i.e., individuals migrating as subadults for the first time) remained within the upper 40 km of the Umatilla River during their first summer in the Umatilla River. We also determined some of these subadults and older ones rearing in the upper Umatilla River undertook staged downstream migrations, for example, emigrating from the North Fork in spring and rearing in the Umatilla River for several months before again initiating downstream migration in fall. We observed no subadults utilizing the heavily impacted lower river. As a result, we were unable to describe the timing of use, seasonal distribution, and movement of subadults in the lower river and determine how subadults might be negatively affected by conditions there. Meeting those objectives seemed unlikely given the small size of the subadult population and the apparently low frequency with which subadults migrated to the lower river; therefore, in 2010, we transitioned to identifying potential bull trout spawning and rearing areas in the basin by conducting a patch analysis (FWS 2008) to begin to resolve uncertainty about the number and distribution of local populations. In 2010 and 2011, we collected water temperature data throughout the Umatilla Basin for use in the patch analysis, conducted the analysis to identify patches, and visited those we were unfamiliar with to eliminate any having no or insufficient stream flow. This process lead to the identification of seven patches, only one of which (the North Fork Umatilla River) was known to support a bull trout local population. One of our objectives in 2012, therefore, was to sample in the remaining patches to determine if bull trout local populations were present, and to collect spawning habitat data to determine if any unoccupied patches could support bull trout spawning. Our second objective was to monitor the movement and determine the origin of any bull trout captured at TMFD to continue to fill in gaps in existing knowledge.

Bull trout in the John Day Basin inhabit the Middle Fork, North Fork, and upper John Day River drainages. When we initiated our study in the basin in 2005, we chose to focus on bull trout from the North Fork. Few migratory individuals remained in the Middle Fork system and those in the upper John Day River and its tributaries had been studied extensively by ODFW from 1997 to 2001.

The John Day River Recovery Unit Team identified seven local populations of bull trout in the North Fork John Day River sub-basin: 1) upper North Fork John Day River (includes Crawfish, Baldy, Cunningham, Trail, Onion, and Crane Creeks and the main stem upstream from Granite Creek), 2) upper Granite Creek (includes Bull Run, Deep, and Boundary creeks), 3) Boulder Creek, 4) Clear/Lightning creeks above the Pete Mann ditch (includes Salmon Creek), 5) Clear Creek below the Pete Mann ditch (includes Lightning Creek below the ditch), 6) Desolation Creek (includes South Fork Desolation Creek below a barrier falls and North Fork Desolation Creek), and 7) South Fork Desolation Creek upstream from the barrier falls (U. S. Fish and Wildlife Service 2002). Leading up to our study, there were no reliable abundance estimates for these populations, but because much of the upper main stem flows through a wilderness area, local biologists suspected its bull trout population, in particular, was relatively healthy. Fluvial bull trout were believed to persist only among the upper North Fork John Day, upper Granite Creek, and Desolation Creek local populations (U. S. Fish and Wildlife Service 2002), and there was evidence indicating their abundance in the latter two local populations was extremely low (P. Howell, U. S. Forest Service [USFS], personal communication; P.M.S., unpublished data). Little information was available on the migratory patterns of these bull trout. Based on observations of two radio-tagged subadults and the incidental capture of fluvial adults by steelhead anglers, it was evident the overwintering area extended downstream into the lower North Fork and John Day River (Hemmingsen et al. 2001b; T. Unterwegner, ODFW, personal communication). The telemetry data also showed subadult migrations could be extensive, with one individual traveling at least 220 km between its winter and summer rearing sites (Hemmingsen et al. 2001b).

There are no dams on the North Fork John Day River and water withdrawals from it are limited to the lower 24 km, where several irrigation pumps are operated. In all but extreme drought years (e.g., 1977), the lower river has sufficient flow to provide fish passage during the irrigation season (T. Unterwegner, ODFW retired, personal communication). The Pete Mann Ditch is the only other significant water diversion in the sub-basin. It traverses a number of tributaries to Clear Creek and diverts varying portions of their flow into the Powder River Basin. Because fluvial bull trout are no longer present in the Clear Creek system, the Pete Mann Ditch currently has the potential to impact only resident bull trout and their localized movements.

The major factor limiting the distribution and movement of bull trout in the North Fork John Day River sub-basin appears to be high summer stream temperatures (Columbia-Blue Mountain Resource Conservation and Development Area 2005). The high stream temperatures are attributed to a lack of streamside shade, increases in fine sediments, altered hydrologic patterns, losses of pool habitat, and low amounts of in-stream wood (Umatilla National Forest and Walla Walla National Forest 1997a and 1997 b cited in Columbia-Blue Mountain Resource Conservation and Development Area 2005). These conditions are a product of past and, to a lesser extent, continuing forest management practices (e.g., logging and fire suppression), grazing, placer and dredge mining, and road construction (Columbia-Blue Mountain Resource Conservation and Development Area 2005). The lower sub-basin's semi-arid climate and loss of forest canopy due to extensive wildfires might also be important naturally-occurring contributing factors. The elevated stream temperatures presumably force bull trout to seek out and remain in colder headwater reaches of the main stem and its tributaries, or any coldwater refuges downstream, during summer. They might also form a thermal block to migration for individuals that fail to ascend the river system in a timely manner.

Although high summer stream temperatures have been proposed as the major factor limiting bull trout in the North Fork John Day River sub-basin (Columbia-Blue Mountain Resource Conservation and Development Area 2005), a more detailed description of the migratory behavior of the sub-basin's bull trout was needed to support this contention and determine where thermal barriers or other factors might be restricting the movement and distribution of those fish. When we initiated work in the North Fork John Day River in 2005, information on both fluvial adult and subadult migrations was limited, but we elected to begin by studying the adults. While angling and operating an upstream migrant trap in the North Fork in 2005-07, we captured only eight large-bodied (>300 mm FL) char, three of which appeared to be brook trout (*Salvelinus confluentus*) x bull trout hybrids rather than pure bull trout. We tagged seven of these fish, including the apparent hybrids. All remained in the upper 77 km of the 180 km-long North Fork throughout the lives of their two-year tags, and none appeared to encounter impediments to their movement. Given the low abundance of fluvial adults, we transitioned in 2009 to studying the seasonal distribution and movement of subadult bull trout. We captured and radio tagged only four subadults in three seasons of trapping, did little to increase existing knowledge of subadult distribution and movement, and seemed unlikely to do so, so we subsequently discontinued this effort. In 2012, our objective was to identify the locations and types of structures in the John Day, North Fork John Day, and Middle Fork John Day rivers that might create potential blockages to fish passage. Our focus was on structures associated with irrigation withdrawals since there had been no recent inventory.

Umatilla Basin

Methods

Patch Occupancy Sampling

We previously identified 24 bull trout patches in the Umatilla Basin (Sankovich and Anglin 2011) and through site visits determined seven had sufficient stream flow to support bull trout spawning and early rearing. These seven patches were in the North Fork and South Fork

Umatilla rivers and Buck, Spring, Shimmiehorn, North Fork Meacham, and Johnson creeks. A viable population of bull trout is known to occur only in the North Fork Umatilla River; thus, for the occupancy sampling we focused on the patches in the remaining six streams.

The methods we used to select sampling sites within patches are described in detail in FWS (2008). To summarize briefly, the sampling sites were selected using a random, spatially balanced design (Generalized Random-Tessellation Stratified design; Stevens and Olsen 2004). Program R (Ihaka and Gentleman 1996) was used to identify sampling sites on a 1:100,000 GIS stream layer at a density of one Universal Transverse Mercator (UTM) coordinate per 500 m. The sampling sites were 50 m long. A master list of sampling sites that included more sites than were needed for the occupancy surveys was generated to ensure enough sites could be sampled if some had insufficient stream flow.

Our goal was to sample nine sites within each patch. This would provide an estimated 93% probability of detecting bull trout in an occupied patch, assuming a conservative detection probability of 20%, according to a model developed by the Research Monitoring and Evaluation Group (FWS 2008). Due to time constraints, we actually were able to sample at nine sites in only two of the patches (Buck and Spring creeks; Figure 1 and Appendix Table 1). In Shimmiehorn Creek, the South Fork Umatilla River, and North Fork Meacham Creek, we sampled in seven sites, providing an estimated 80% probability of detecting bull trout if those patches were occupied. No sites were sampled in Johnson Creek due to time constraints.

We conducted the occupancy sampling in late June and July. We sampled by electrofishing as described in Hudson et al. (2010). We also collected the habitat data Hudson et al. (2010) collected so the relationship between various habitat variables and site-specific detection probability might be evaluated in the future. In addition to the water depth measurements taken in this process, we collected water velocity and substrate composition data to grossly assess the availability of spawning habitat. Water depth and velocity and substrate size have been shown to be the most important predictors of bull trout spawning habitat (FWS, unpublished report). Within each 50-m sampling site, the habitat data were collected at six transects spaced 10 m apart. Substrate composition was assessed within a 1-m square area at one to three locations along each transect, depending on the transect width. It was assessed at ¼, ½, and ¾ the transect width for transects 3 m or more wide, at ¼ and ¾ the transect width for transects between 1 and 3 m wide, and at ½ the transect width for transects 1 m or less wide. Based on visual estimation, we categorized the dominant and subdominant substrate into six size categories: <6 mm (1/4 in), 7 - 25 mm (1/4 - 1 in), 26 - 50 mm (1 - 2 in), 51 - 76 mm (2 - 3 in), 77 - 152 mm (3 - 6 in), and >153 mm (6 in). Water depth and velocity were measured in the approximate center of each 1-m square area. Water velocity measurements were taken at the stream bottom (nose velocity) and at 60% of the depth from the surface (average velocity) using a model 2000 March-McBirney, Inc. Flo-Mate.

Our objective in collecting the spawning habitat data was to provide a general assessment, rather than a highly quantitative analysis, of spawning habitat in each patch. We used data collected from 269 bull trout redds in the South Fork Walla Walla River to identify bull trout spawning habitat (U.S. Fish and Wildlife Service, unpublished report). Water depth at the upstream end of the pit of those redds ranged from 0.06 to 0.73 m. Nose and average water velocity ranged from 0 to 0.56 m/s and 0 to 0.86 m/s, respectively. The dominant substrate fell into the four smallest size categories listed above and the subdominant substrate fell into all

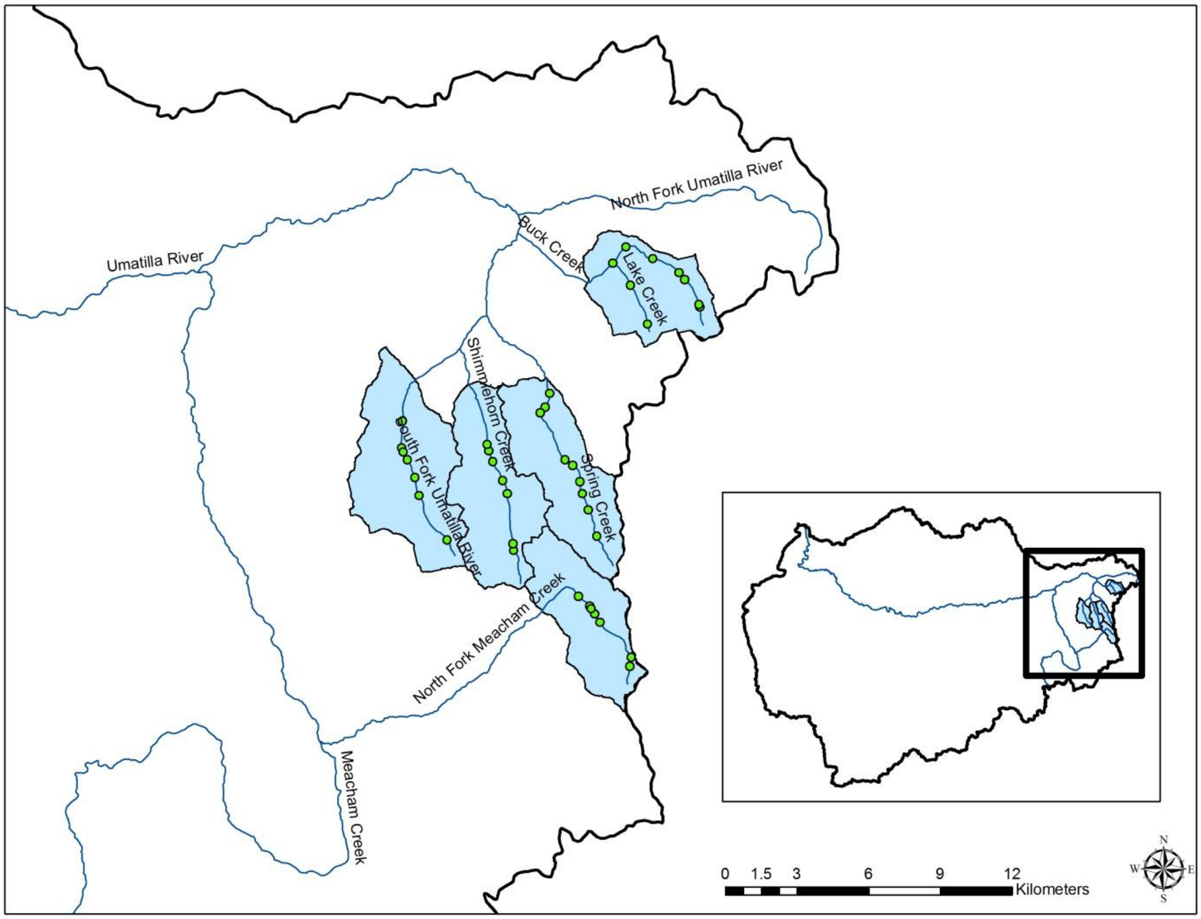

Figure 1. Location of bull trout patches and sites within them that were sampled to determine bull trout occupancy in summer 2012.

but the largest size category. We filtered our habitat data according to these criteria to identify potential spawning sites.

Movement and Origin of Bull Trout Captured at Three Mile Falls Dam

To monitor the movement of bull trout captured at TMFD (Figure 2), we PIT tagged them and queried the Pacific States Marine Fisheries Commission's PTAGIS database to determine if they were detected at any PIT tag detection sites in the Columbia River Basin during the year. The detection site of primary interest on the Umatilla River was Feed Canal Dam, at rkm 45. Detection of fish there would indicate successful passage throughall of the dams in the lower river, except Stanfield Dam. Two routes of passage at Feed Canal Dam—a ladder and a notch in the dam—were outfitted with PIT tag antennas. Fish may also pass the dam by jumping it, but this appears to occur infrequently (B. Duke, ODFW, personal communication), so detection efficiency presumably was high.

Personnel from the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and ODFW operated a trap in the east bank ladder at TMFD, and, initially, notified us when bull

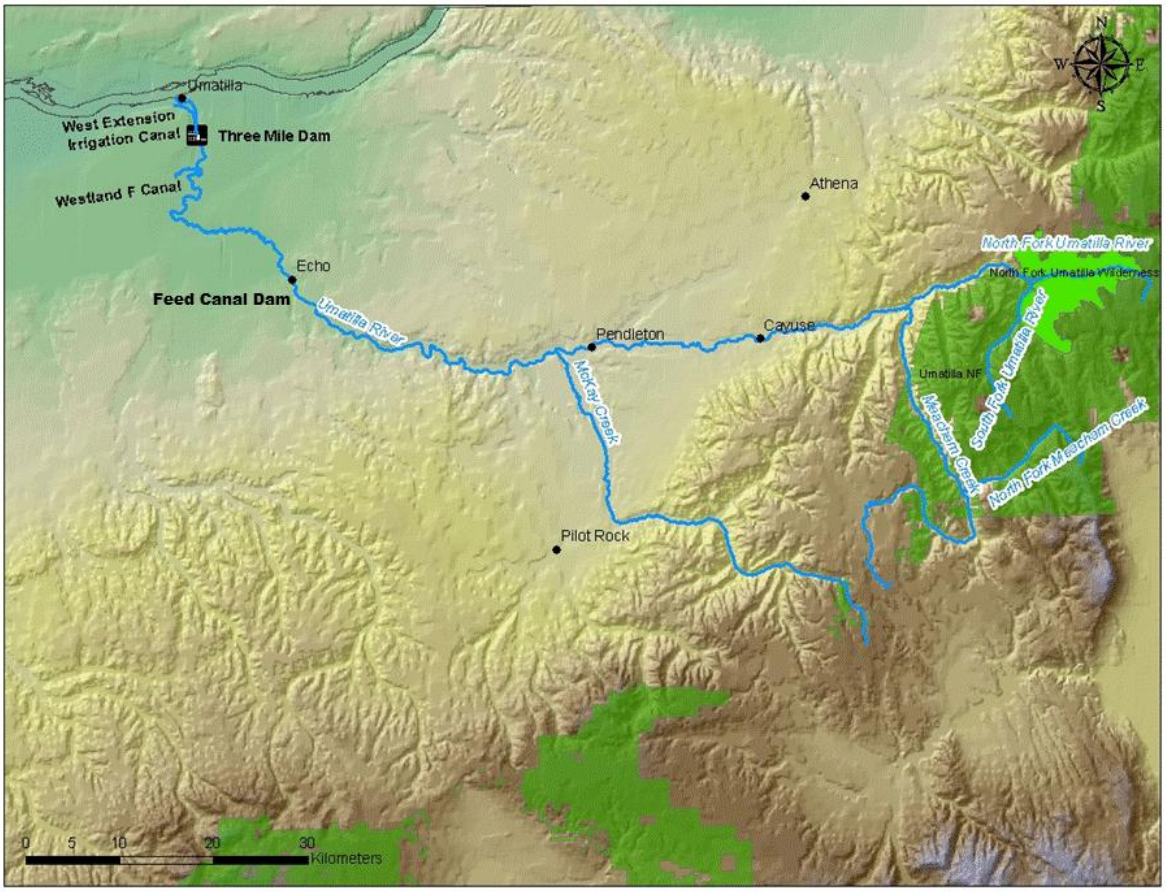

Figure 2. Map showing the location of Three Mile Falls Dam and relevant landmarks in the Umatilla Basin.

trout were captured in the trap so we could tag and collect genetic samples from them. During our second visit to the site, we provided training to staff operating the trap, and they tagged and collected genetic samples from bull trout captured thereafter. The bull trout were held in a live cage in the anadromous adult holding pond at TMFD and tagged the morning of their capture or the following morning. Our PIT tagging methods followed those described by Anglin et al. (2008), except the tags were inserted under the skin rather than in the abdomen through an approximately 4-mm incision made with a surgical blade anterior to the pelvic girdle and slightly off the mid-line. The PIT tags were 23 mm long. We collected duplicate fin tissue samples from each fish for genetic analyses to determine if they originated in- or outside the Umatilla Basin. The samples were stored in vials in 95% ethanol. All tagged fish were released in the pool upstream from TMFD following their recovery from anesthesia.

The genetic analyses were conducted by the Washington Department of Fish and Wildlife Genetics Laboratory in Olympia, Washington. Details of the analytical methods and results are provided in Small et al. (2012).

Results

Patch Occupancy Sampling

We did not observe or capture any bull trout in the five patches sampled. The only fish species encountered were steelhead or rainbow trout (*Oncorhynchus mykiss*) and sculpin (*Cottus spp.*), and individuals of these species were not abundant. *O. mykiss* were captured in all of the patches except that in North Fork Meacham Creek, where no fish were captured or observed (Appendix Table 2). Overall, *O. mykiss* were present in 17 of 39 sampling sites, and those sites were located in the lower sections of the patches. The average number of *O. mykiss* captured per sampling site was 1.7. Sculpin were captured in only one sampling site in Spring Creek and two sampling sites in the South Fork Umatilla River.

A vast majority of the sites where spawning habitat data were collected contained habitat conditions that did not meet all of the five criteria for spawning habitat we developed from data collected in the South Fork Walla Walla River. The percentage of sites meeting those criteria ranged from 0% in the South Fork Umatilla River to 9% in Spring Creek (Table 1). At most sites (74 to 100%; Table 2), the dominant substrate size, subdominant substrate size, or both was larger than that used by bull trout in the South Fork Walla Walla River. At sites where the

Table 1. Number and percentage of transect sites within sampling sites containing habitat conditions meeting five criteria used to describe spawning habitat (outlined in the Methods).

Patch	Number of sites	Number meeting all criteria (%)
Buck Cr.	96	6(6.3)
Spring Cr.	87	8(9.2)
Shimmiehorn Cr.	72	3(4.2)
SF Umatilla R.	72	0(0.0)
NF Meacham Cr.	60	1(1.7)

Table 2. Number and percentage of transect sites within sampling sites containing large substrate (dominant substrate >77 mm in diameter, subdominant substrate >153 mm in diameter, or both).

Patch	Number of sites	Number with large substrate(%)
Buck Cr.	96	71(74)
Spring Cr.	87	72(83)
Shimmiehorn Cr.	72	70(97)
SF Umatilla R.	72	72(100)
NF Meacham Cr.	60	52(87)

substrate was sufficiently small, depth tended to be insufficient. In all but one case, nose and average velocities were within the ranges observed at redds in the South Fork Walla Walla River.

Movement and Origin of Bull Trout Captured at Three Mile Falls Dam

Three bull trout ranging from 305 to 380 mm in fork length were captured at TMFD in May (Table 3). One had been PIT tagged previously in the Walla Walla River in November 2011. Genetic analyses indicated all originated in the Walla Walla River (Small et al. 2012). None were detected at any of the PIT tag detection sites in the Columbia River Basin during 2012. That they were not detected at Feed Canal Dam, at rkm 45 on the Umatilla River, suggests they did not migrate upstream out of the lower river.

Table 3. Date of capture, PIT tag code, and fork length of bull trout trapped at Three Mile Falls Dam in 2012.

Date of capture	PIT tag code	FL (mm)
05/05/12	3D9.1BF1FDCEF7	345
05/09/12	384.1B795B26A9	380
05/15/12	3D9.1BF1B29947	305

Discussion

The Bull Trout Draft Recovery Plan (FWS 2002) identified one subpopulation of bull trout in the Umatilla Basin. It was termed the upper Umatilla Complex and included bull trout in the North Fork and South Fork Umatilla rivers. In a subsequent unpublished revised draft of Chapter 10 in the Bull Trout Draft Recovery Plan (FWS 2004b) that subpopulation (termed a local population in the revised draft) was identified along with a local population in North Fork Meacham Creek. The South Fork Umatilla River and North Fork Meacham Creek were included based on infrequent observations of bull trout or redds attributed to them in those streams in the 1990s and early 2000s. Based on our patch analysis (Sankovich and Anglin 2011), reconnaissance surveys of putative patches in 2011, and occupancy sampling in 2012, it appears bull trout currently occur only in the North Fork Umatilla River. We did not sample in one patch that was identified (Johnson Creek), but we believe it was the least likely of the patches to be occupied by bull trout based on its small size and the narrow width and shallow depth of the stream section within it. Because our probability of detecting bull trout in an occupied patch was not 100%, we cannot rule out the possibility of there being bull trout in the patches we sampled. We believe the combined evidence from the occupancy sampling (no bull trout captured or observed) and spawning habitat assessments (little to no spawning habitat identified) indicate it is highly unlikely the North Fork Meacham Creek and South Fork Umatilla River patches support bull trout. In addition to containing little spawning habitat, the North Fork Meacham Creek patch lies upstream of an apparent passage barrier (C. Contor, CTUIR, personal communication). Migratory bull trout may not have access to the patch. That we caught no *O. mykiss* in the patch supports this contention.

Of the remaining patches, Buck Creek might hold the most potential to support bull trout.

Spawning habitat in it, while not abundant, was more prevalent than in all of the other patches except in Spring Creek. In addition, Buck Creek appears sufficiently cold to support bull trout spawning and early rearing based on the stream temperatures we recorded in it as part of the patch analysis and during the occupancy sampling. All were below 16°C, which is threshold used to identify bull trout patches (FWS 2008). Buck Creek might also be the most likely patch to be colonized by bull trout, if, as our results indicated, they currently are not present, since its mouth is only about 800 m from the mouth of the occupied North Fork Umatilla River. The Shimmiehorn Creek patch, while also apparently cold enough to support bull trout spawning and early rearing, had limited spawning habitat and three potential barriers (falls) near its mid-point. We captured *O. mykiss* in each of the four sampling sites below those potential barriers, but did not catch or observe any fish above them. Although Spring Creek was predicted to be cold enough to support bull trout spawning and early rearing based on our patch analysis (Sankovich and Anglin 2011), it actually might not be. During the occupancy sampling, stream temperatures in the lower five sites were 13.8, 15.2, 14.8, 15.0, and 14.0 °C (at 12:53, 14:25, 15:46, 13:15, and 11:55, respectively). Those temperatures were recorded on 9 and 10 July, in advance of the period in late July or August when maximum stream temperatures occur.

In 2007 and 2010, we radio and PIT tagged five bull trout at TMFD (Sankovich and Anglin 2008, 2011). Four of these fish migrated past the six irrigation dams in the lower Umatilla River. Given this prior demonstration of the ability of bull trout to negotiate conditions in the lower Umatilla River, we are uncertain why the three fish PIT tagged at TMFD in 2012 were not detected at Feed Canal Dam. They may have died in the section of river between TMFD and Feed Canal Dam, as did one of the fish tagged in 2010, or they may have returned to the Columbia River and continued their migration elsewhere. Unless they located a cold water refuge, remaining in the lower river through the summer would not have been possible given the high stream temperatures there. A final possibility is that they jumped Feed Canal Dam and avoided being detected there, but as noted above, this type of behavior appears to occur infrequently (B. Duke, ODFW, personal communication). We will continue to query the PTAGIS database to attempt to track these fish.

Small et al. (2012) determined not only that the three bull trout trapped at TMFD in 2012 originated outside the Umatilla River, but also that the same was true of the five bull trout we sampled at TMFD in 2007 and 2010 (four were assigned to the Walla Walla River, and one was assigned to the Tucannon River). There are several implications to these findings. First, since one of those fish migrated onto the spawning grounds in the North Fork Umatilla River and was present there during the spawning period, some evidence now exists of biological connectivity between bull trout in the Umatilla Basin and a neighboring basin. Given the small size of the bull trout population in the North Fork Umatilla River, managers may need to consider the trade-off in risks between inbreeding and outbreeding depression for that population in the future. Second, there is also now some evidence for the possibility of colonization or re-colonization of vacant habitat in the Umatilla Basin by bull trout originating outside the basin. Based on our work, areas with suitable habitat conditions appear limited, so this may be more important in the future if habitat conditions are improved. Third, our past studies and those of others have failed to demonstrate use of the lower Umatilla River by bull trout from the upper basin (Sankovich et al. 2003, 2004; Sankovich and Anglin 2006, 2007, 2008, 2009, 2010; ODFW, unpublished report). Given the occasional appearance of bull trout at TMFD, we assumed that failure was due partly to the small number of bull trout remaining in the basin and the infrequent rate at which individuals migrated to the lower river. This assumption may be incorrect since none of the bull trout sampled at TMFD since 2007 originated in the Umatilla Basin. The movement of migratory adult and subadult bull trout in the Umatilla Basin may, in fact, be restricted relative to the movements of bull trout in some other systems. There are no obvious reasons this might be so, at least during the colder months of the year when stream temperatures are suitable for bull trout throughout the Umatilla River. Starcevich et al. (2012) suggested it might be due to land and water use practices. Other plausible explanations exist, including that at low density, bull trout may not need to migrate far in the Umatilla River to find suitable rearing and foraging habitat.

John Day Basin

Methods

We flew a fixed-winged aircraft (Cessna 182J) to survey the main stems of the John Day, North Fork John Day, and Middle Fork John Day rivers and document potential blockages to fish passage. We conducted the survey late in the irrigation season on 28-29 August to allow time for structures like push up dams to be constructed. The John Day River was surveyed from the Malheur National Forest boundary in its headwaters to its mouth. The North Fork John Day River was surveyed from its confluence with the Middle Fork John Day River to its mouth. No agriculture occurs along the North Fork John Day River upstream from the mouth of the Middle Fork. The Middle Fork John Day River was surveyed from its headwaters to its mouth. When we located a structure in the stream, we circled the aircraft and took photos of the structure. We then recorded the coordinates, type of structure, extent to which it spanned the stream, whether it was associated with an irrigation ditch or pump, and if it was associated with a ditch, whether the ditch was screened. This information, along with the photos and a map showing the location of all the structures was shared with personnel from ODFW's District Office in John Day and Grant County Soil and Water District so that in consultation with them we could determine which structures were designed to provide fish passage and which were not and might be forming a blockage.

Results

We found 25 structures in the main stems of the John Day, North Fork John Day, and Middle Fork John Day rivers (Figure 3; Table 4). Twenty-four were in the main stem John Day River, all upstream from the mouth of the North Fork John Day River, and one was in the Middle Fork John Day River near rkm 72. No structures were observed in the North Fork John Day River. Seventeen of the structures in the John Day River were identified as push up dams, and seven were identified as lay flat stanchion dams, which are designed to provide fish passage (Table 4). Two of the push up dams (sites 15 and 21) were obviously impassable, while another four (sites 9, 17, 18, and 19) might have been, but it was not possible to determine unequivocally from the air if they were. Eight of the push up dams (sites 1, 2, 3, 4, 13, 17, 19, and 22; Table 4) are proposed to be replaced with lay flat station dams between 2013 and 2019. The design of the sole structure in the Middle Fork John Day River could not be determined (Table 4).

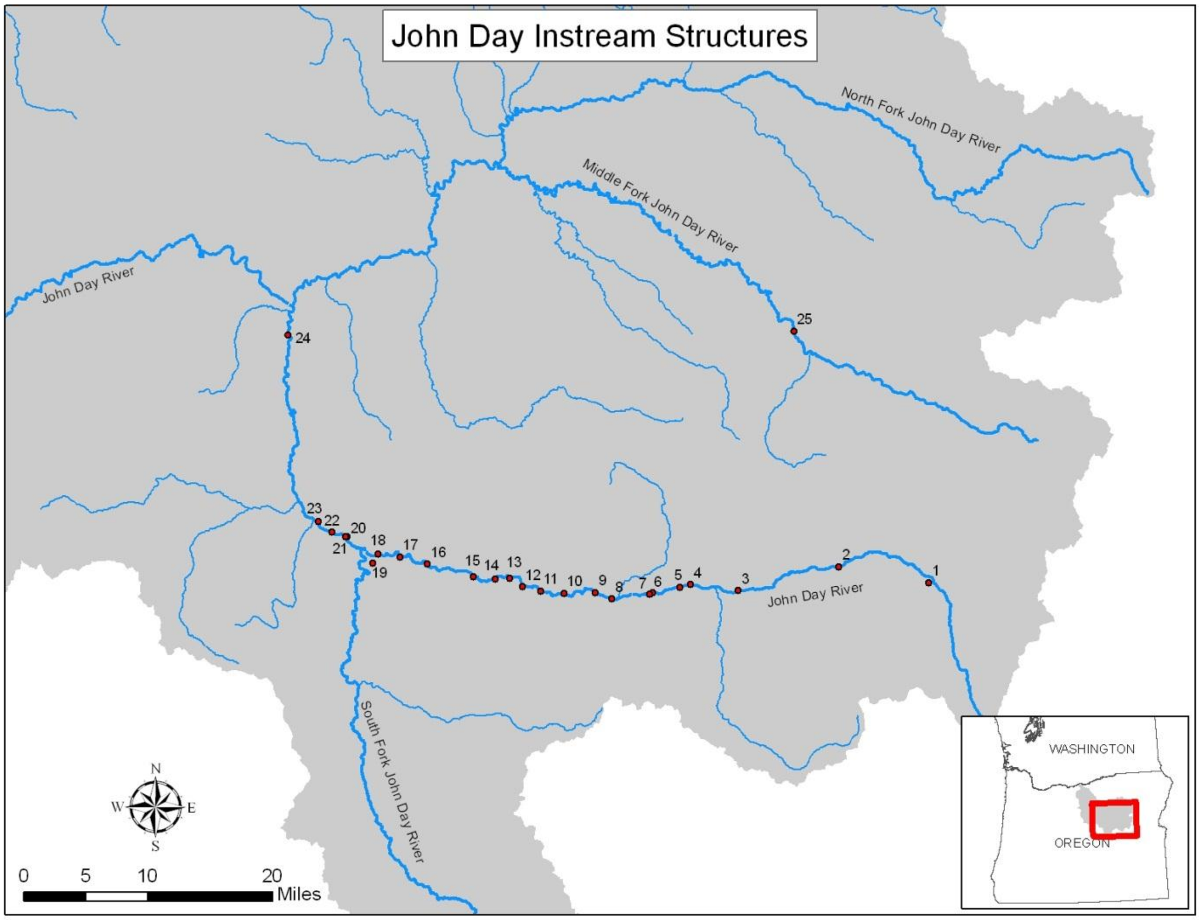

Figure 3. Location of structures in the main stems of the John Day, Middle Fork John Day, and North Fork John Day rivers in August 2012.

Discussion

Based on results from a radio telemetry study (Hemmingsen et al. 2001b) and on the incidental capture of bull trout in a screw trap at rkm 326 in the John Day River (e.g., Wilson et al. 2007), it is evident some bull trout from local populations in the upper John Day River use the stream section containing all but one (the lower-most) of the irrigation structures we documented in the John Day River. It is also evident bull trout may pass through that river section successfully under certain conditions, presumably after impassable structures have been naturally removed by high stream flow, or stream flow has increased sufficiently to allow fish to pass over those structures. Prior to becoming passable, those structures could delay the downstream migration of subadult and adult bull trout in fall and winter. Migratory bull trout do not tend to move extensively after reaching their wintering area (Starcevich et al. 2012), but impassable structures could also interfere with the localized movements of individuals wintering near them. In spring and summer, upstream movements of adults during their spawning run, and of any subadults or immature adults attempting to avoid increasing water temperatures, could be negatively impacted depending on the timing of those movements and the timing with which the irrigation structures from the previous year are naturally removed by high stream flows, and new

Table 4. Locations (in UTMs, WGS 84) and types of structures in the John Day and Middle Fork John Day rivers in August 2012, and proposed year of replacement of some of those structures. Site locations are given in Figure 3.

Site	Type of diversion	Location (UTM)		Proposed year of replacement
		Easting	Northing	
1	push-up dam	371606	4919997	2015
2	push-up dam	360154	4922560	2015
3	push-up dam	347030	4920015	2019
4	push-up dam	340889	4921081	2018
5	lay flat dam	339547	4920815	
6	push-up dam	335988	4920222	
7	lay flat dam	335580	4920079	
8	lay flat dam	330681	4919639	
9	push-up dam	328493	4920537	
10	push-up dam	324507	4920619	
11	lay flat dam	321467	4921070	
12	lay flat dam	319180	4921700	
13	push-up dam	317604	4922919	
14	lay flat dam	315756	4922905	
15	push-up dam	312932	4923250	2013
16	lay flat dam	307062	4925163	
17	push-up dam	303505	4926247	2016
18	push-up dam	300746	4926728	
19	push-up dam	299955	4925572	2014
20	push-up dam	296770	4929103	
21	push-up dam	296595	4929138	
22	push-up dam	294927	4929788	2016
23	push-up dam	293169	4931229	
24	push-up dam	290316	4955430	
25	unknown	355681	4953135	

instream structures are constructed.

Migratory bull trout do not appear to be prevalent among the local populations in the Middle Fork John Day River (U.S. Fish and Wildlife Service 2002), but they have been captured occasionally in a screw trap at rkm 24 on the Middle Fork in recent years (Wilson et al. 2007). Therefore, the potential exists for the single structure we found in the Middle Fork to impede the movements of migratory bull trout in the same manner described above for bull trout in the John Day River. Since we were unable to identify the design of the structure in the Middle Fork, a logical next step would be to visit the site on the ground and determine if it impedes fish passage.

The North Fork John Day River drainage supports seven recognized local populations of bull trout (U.S. Fish and Wildlife Service 2002). Migratory bull trout are believed to be present in three of these, but they are not abundant (Sankovich and Anglin 2006, 2007, 2008 2009; ODFW, unpublished data). The factor(s) limiting their abundance, both in the local populations where they occur and those where they do not (excluding those above barriers), are not known. We found no irrigation structures or other impediments to fish passage in the North Fork John Day River and the lower 301 km of the John Day River. Thus, an inability of migratory fish to move freely throughout those areas, at least during the colder months of the year when stream temperatures are suitable, can be ruled out as a factor. A more likely factor may be the thermal barriers created by high stream temperatures during the warmer months of the year. Migratory bull trout are likely limited to cooler headwater areas during this period (U.S. Fish and Wildlife Service 2002), and this restriction to their movement could limit their abundance.

Acknowledgements

Funding for this study was provided by the the U.S. Fish and Wildlife Service, through the XFIT project funding process and other sources. We thank Brianne Ankenman, Aaron Mettler, and Emily Petersen for their assistance in the field with the occupancy sampling; the CRFPO's Conservation and Assessment Team for technical assistance with the occupancy sampling; Mike Richards and other staff of the Confederated Tribes of the Umatilla Indian Reservation and Wes Stonecypher of the Oregon Department of Fish and Wildlife for their assistance with our tagging efforts at Three Mile Falls Dam; Steve Reid of Skyrunners Corp. for piloting the aircraft used to survey the John Day Basin; David Hines of the CRFPO for producing some the figures in this document; Jason Kehrberg and Kyle Sullivan of the Grant County Soil and Water Conservation District and Jeff Neal of the Oregon Department of Fish and Wildlife for their help identifying the types of structures in the John Day Basin; and Jeff Neal and Bill Duke, also of the Oregon Department of Fish and Wildlife, for supporting our work in their districts.

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Appendix Table 1. Coordinates (UTM system, Zone 11, NAD83) of sites sampled to assess bull trout occupancy in patches in the Umatilla Basin in 2012.

		Coordinates	
Stream	Site	Easting	Northing
Buck Creek	1	415099	5060414
Lake Creek	3	412212	5061342
Buck Creek	4	414476	5061568
Lake Creek	5	411459	5062259
Buck Creek	6	412016	5062932
Lake Creek	7	412920	5059707
Buck Creek	8	414228	5061855
Buck Creek	9	413147	5062445
Buck Creek	11	415074	5060523
Spring Creek	1	410796	5050862
Spring Creek	2	409481	5054049
Spring Creek	3	409789	5053806
Spring Creek	6	410203	5052632
Spring Creek	8	410097	5053123
Spring Creek	9	408640	5056243
Spring Creek	13	410441	5051952
Spring Creek	14	408436	5056007
Spring Creek	15	408819	5056808
Shimmiehorn Creek	1	406461	5053962
Shimmiehorn Creek	3	407047	5052629
Shimmiehorn Creek	6	407329	5050254
Shimmiehorn Creek	8	406871	5053178
Shimmiehorn Creek	13	406283	5054419
Shimmiehorn Creek	15	406215	5054678
Shimmiehorn Creek	16	407292	5050533
South Fork Umatilla River	6	402674	5055658
South Fork Umatilla River	7	403368	5052547
South Fork Umatilla River	8	402876	5054047
South Fork Umatilla River	11	403201	5053305
South Fork Umatilla River	12	402639	5054537
South Fork Umatilla River	23	404544	5050702
South Fork Umatilla River	26	402701	5054367
North Fork Meacham Creek	1	410924	5047245
North Fork Meacham Creek	2	412240	5045799
North Fork Meacham Creek	7	410020	5048339
North Fork Meacham Creek	9	410706	5047600
North Fork Meacham Creek	10	412185	5045412
North Fork Meacham Creek	12	410503	5047924
North Fork Meacham Creek	23	410560	5047824

Appendix Table 2. Number of *O.mykiss* and sculpin and size range of *O. mykiss* captured in sampling sites in bull trout patches in the Umatilla Basin in 2012.

		Number of fish captured		*O. mykiss* size
Patch	Site	*O. mykiss*	Sculpin	range (mm)
Buck Cr.	1	0	0	
	11	0	0	
	4	0	0	
	8	0	0	
	7	0	0	
	3	0	0	
	9	6	0	50 -150
	6	5	0	75 - 150
	5	6	0	50 - 175
Spring Cr.	1	0	0	
	13	0	0	
	6	0	0	
	8	2	0	175
	3	3	0	75 - 100
	2	3	0	50 - 75
	14	6	0	50 - 100
	9	2	0	75 - 100
	15	3	1	50
Shimmiehorn Cr.	6	0	0	
	16	0	0	
	3	0	0	
	8	2	0	175
	1	3	0	125 - 150
	15	4	0	50 - 200
	13	6	0	75 - 150
SF Umatilla R.	7	0	0	
	11	0	0	
	8	0	1	
	26	2	0	75 - 100
	12	2	0	50 - 175
	6	5	0	75 - 150
	23	10	1	50 - 175
NF Meacham Cr.	10	0	0	
	2	0	0	
	1	0	0	
	9	0	0	
	23	0	0	
	12	0	0	
	7	0	0	